

## CLAIMS

What is claimed is:

- 1 1. A method comprising:  
2 accessing a first multi-dimensional graphical matrix representation that  
3 describes the appearance of a plurality of points of an object from a plurality of  
4 viewing directions, the appearance varying from point to point and viewing direction  
5 to viewing direction;  
6 creating a second graphical representation that approximates the first graphical  
7 representation and that includes at least one expression having a fewer dimensions  
8 than the first multi-dimensional graphical representation by decomposing the first  
9 multi-dimensional graphical representation into the second graphical representation,  
10 the decomposing including sign consistent matrix factorization to selectively represent  
11 information from the first graphical representation.
- 1 2. The method of claim 1, wherein the sign consistent matrix factorization  
2 comprises non-negative matrix factorization.
- 1 3. The method of claim 1, wherein the sign consistent matrix factorization  
2 comprises alternating sign matrix factorization.
- 1 4. The method of claim 1, further comprising:  
2 accessing a third multi-dimensional graphical representation that describes the  
3 appearance of a second plurality of points of the object from a plurality of viewing  
4 directions, the second plurality of points including the first plurality of points, and the  
5 appearance varying from point to point and viewing direction to viewing direction;  
6 and  
7 partitioning the third multi-dimensional graphical representation into a  
8 plurality of smaller multi-dimensional graphical representations each associated with a

9 primitive of a polygonal representation of the geometry of the object, the plurality of  
10 smaller multi-dimensional graphical representations including the first multi-  
11 dimensional graphical representation.

1 5. A machine-readable medium having stored thereon data representing  
2 sequences of instructions that when executed cause a machine to perform operations  
3 comprising:

1 access of a first multi-dimensional graphical matrix representation that  
2 describes the appearance of a plurality of points of an object from a plurality of  
3 viewing directions, the appearance varying from point to point and viewing direction  
4 to viewing direction;

5 creation of a second graphical representation that approximates the first  
6 graphical representation and that includes at least one expression having a fewer  
7 dimensions than the first multi-dimensional graphical representation by decomposing  
8 the first multi-dimensional graphical representation into the second graphical  
9 representation, the decomposing including sign consistent matrix factorization to  
10 selectively represent information from the first graphical representation.  
11

12 6. A machine-readable medium of claim 5 having stored thereon data  
13 representing sequences of instructions that when executed cause a machine to perform  
14 operations comprising a non-negative matrix factorization when performing the sign  
15 consistent matrix factorization.

16

17 7. A machine-readable medium of claim 5 having stored thereon data  
18 representing sequences of instructions that when executed cause a machine to perform

19 operations comprising an alternating sign matrix factorization when performing the  
20 sign consistent matrix factorization.

21

22 8. A machine-readable medium of claim 5 having stored thereon data  
23 representing sequences of instructions that when executed cause a machine to perform  
24 operations comprising

25 access of a third multi-dimensional graphical representation that describes the  
26 appearance of a second plurality of points of the object from a plurality of viewing  
27 directions, the second plurality of points including the first plurality of points, and the  
28 appearance varying from point to point and viewing direction to viewing direction;  
29 and

30 partition of the third multi-dimensional graphical representation into a plurality  
31 of smaller multi-dimensional graphical representations each associated with a  
32 primitive of a polygonal representation of the geometry of the object, the plurality of  
33 smaller multi-dimensional graphical representations including the first multi-  
34 dimensional graphical representation.

1 9. A data structure comprising  
2 at least a first portion and a second portion, the second portion including a  
3 second plurality of view-dependent subportions including a first view-dependent  
4 matrix that corresponds to a first viewing direction and a second view-dependent  
5 matrix that corresponds to a second viewing direction, wherein the first portion and  
6 the first view-dependent subportion are combinable using multitexturing hardware that  
7 allows multiple textures to be concurrently applied to a primitive in a single rendering  
8 pass to display a plurality of points of an object with a first appearance corresponding  
9 to a first viewing direction, and wherein the first portion and the second view-

10. The data structure of claim 9, wherein the data structure is derived from a plurality of images acquired for the object by selectively representing information from the plurality of images that is important to describe the appearance of the object and selectively removing information from the plurality of images that is redundant.

1     11.     The data structure of claim 9, wherein the first portion and the first view-  
2     dependent subportion are combinable without decompression using the multitexturing  
3     hardware.

1     12.     The data structure of claim 9, wherein the first portion and the second portion  
2     are created by decompressing a corresponding compressed first portion and a  
3     corresponding compressed second portion of another data structure.

1     13.     A system comprising  
2             a hardware module that accesses a first multi-dimensional graphical matrix  
3     representation that describes the appearance of a plurality of points of an object from a  
4     plurality of viewing directions, the appearance varying from point to point and  
5     viewing direction to viewing direction;

6 a matrix multiplication module in the hardware module that computes a second  
7 graphical representation that approximates the first graphical representation and that  
8 includes at least one expression having a fewer dimensions than the first multi-  
9 dimensional graphical representation by decomposing the first multi-dimensional  
10 graphical representation into the second graphical representation, the decomposing  
11 including sign consistent matrix factorization to selectively represent information from  
12 the first graphical representation.

1 14. The system of claim 13, wherein the sign consistent matrix factorization  
2 comprises non-negative matrix factorization.

1 15. The system of claim 13, wherein the sign consistent matrix factorization  
2 comprises alternating sign matrix factorization.

1 16. The system of claim 1, further comprising:

2 a submodule of the hardware module that accesses a third multi-dimensional  
3 graphical representation that describes the appearance of a second plurality of points  
4 of the object from a plurality of viewing directions, the second plurality of points  
5 including the first plurality of points, and the appearance varying from point to point  
6 and viewing direction to viewing direction; and further partitions the third multi-  
7 dimensional graphical representation into a plurality of smaller multi-dimensional  
8 graphical representations each associated with a primitive of a polygonal  
9 representation of the geometry of the object, the plurality of smaller multi-dimensional  
10 graphical representations including the first multi-dimensional graphical  
11 representation.